DDA/RTE hybrid method for predicting the scattering properties by densely packed media

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The increment of the particle density in a target significantly affect the interference between scattering fields by these particles, so the single scattering properties become questionable in densely packed media. Many geophysical materials, i.e., snow, bare soil and regolith surfaces are dense particulate matters and to retrieve their optical characteristic, an exact and fast methodology which applies to packed particle conditions is required.

Methods based on the direct simulation are the most accurate approaches to compute the directional scattering properties; however, such techniques become problematic for optically thick targets due to the large-scale computations. Radiative transfer theory (RTT), on the other hand, fails to model directional reflectance and transmittance characteristics of particulate media with volume fraction larger than 5% [1] due to the far-field assumption, e.g., particles are located in the far-field zone of each other.

In this work, a hybrid methodology composed of the exact and numerical radiative transfer equation is described and applied for particulate materials with large volume fraction. For exact method, a new plane wave plane parallel (PWPP) algorithm [2], based on the discrete dipole approximation, has been used to predict the reflection and transmission matrices for layer sufficiently thick to account for particle interaction effects. Then the optically thick properties are obtained by applying the adding and doubling method on the layer.

References

[1] B. Ramezanpour and D. W. Mackowski, 2017: Radiative transfer equation and direct simulation prediction of reflection and absorption by particle deposits. *J. Quant. Spectrosc. Radiat. Transfer* **189**, 361–368.

[2] D. W. Mackowski and B. Ramezanpour, 2018: A plane wave model for direct simulation of reflection and transmission by discretely inhomogeneous plane parallel media. *J. Quant. Spectrosc. Radiat. Transfer*, submitted.

Preferred mode of presentation: Oral